

TIA JUANA TO SAN JOSE DEL CABO—A BOTANICAL
EXPEDITION THROUGH LOWER CALIFORNIA

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On April 2, 1931, accompanied by Professor James McMurphy as assistant, mycologist, and camping companion extraordinary, I crossed the international boundary at Tia Juana to drive the length of Lower California, collect material for the Dudley Herbarium, and make a brief reconnaissance of the peninsular flora. Despite exaggerated reports concerning the impassability of the roads due to recent cloud-bursts we experienced comparatively little difficulty in negotiating the primitive roads and reaching San José del Cabo at the southern tip of the peninsula.

A number of plants were too immature for herbarium specimens when we passed them on the southward journey and were noted for more detailed attention on the return trip. Unfortunately we lost nearly three weeks at San José del Cabo and a great many of the plants so noted had to be neglected on the return trip as the time remaining was very limited. Then, too, a number of them had already passed the flowering or fruiting stages we wished to secure. The latter was particularly true of some of the cacti. However, we obtained a fair representation of the plants in condition to collect at the time we visited the various localities.

The vegetation of Lower California differs little from that of southern California over most of the first two hundred and twenty-five miles. South of the border there are a few species which do not reach the United States, and these give a slightly different aspect to the landscape, the number of such species materially increasing as one travels south. A number of others that are rare in California become more abundant in Lower California. Among the latter is *Bergerocactus emoryi*, rare in California. A few small colonies of this interesting cactus are growing on Santa Catalina and San Clemente islands. Twenty years ago it was rare but still present in the vicinity of National City in San Diego County, but cactus enthusiasts have nearly, if not completely, wiped it out in that locality. Fifteen miles south of Tia Juana the contrast is striking, for here it is present in abundance and for a distance of over two hundred miles one seldom loses sight of it on the coastal slopes and mesas. *Machaerocereus gummosus*, the "Pitahaya agria" of the Mexicans, is encountered along the coastal bluffs a short way north of Ensenada and is common in the coastal region from there south to the tip of the peninsula. *Myrtilocactus cochal*, the fruit of which is highly prized by the natives, is common from Cabo Colnett southward and occurs sparingly as far north as Ensenada.

Aesculus parryi is a conspicuous shrub, during the spring, from a little ranch thirty miles north of Ensenada southward almost to the ruins of Mission San Fernando. The leaves are silvery-tomentose on the

lower surface and brighten the grays and dull greens of the landscape with flashes of silver when light winds stir the foliage. A few miles south of the border *Agave shawii* becomes abundant, and numerous species of this genus are conspicuous over a great part of the peninsula. The young flower stalks of almost every species are used for food or in the manufacture of mescal. In this same region the scarlet flowers of *Galvezia juncea* add a touch of bright color and an enormous *Dudleya*, which may be *D. pulverulenta*, is conspicuous on the basaltic cliffs of the mesas and arroyos. *Cneoridium dumosum* and *Simmondsia californica* are much more plentiful than they are in San Diego County, and the flowers of *Rhus integrifolia* are a brighter deeper rose than they are north of the international boundary line.

From Tia Juana to Rosario, a distance of 236 miles, the road is never more than a few miles from the coast, but at the latter village it swings eastward toward El Marmol, an onyx-mining town about two-thirds of the way across the peninsula. A short distance eastward on this road a change of marked degree begins to manifest itself in the flora. *Adenostoma fasciculatum* disappears from the hills as its southern limit is on the south flanks of the Sierra San Pedro Martir. *Arctostaphylos bicolor* is seen only near the coast, *Pachycereus pringlei* no longer occurs as scattered specimens only, but forms extensive forests. *Yucca valida*, *Viscainoa geniculata*, and *Idria columnaris* put in their appearance and from the vicinity of El Marmol southward most of the peninsula is occupied by the Lower Sonoran flora.

We paid particular attention to the southernmost extension of the range of a number of the species found in southern California, and found that the majority of them do not extend beyond the southern tip of the Sierra San Pedro Martir, and a considerable number seems to drop out before this point is reached. *Ribes malvaceum* was not seen south of Santo Tomas; *Allium praecox* and *Dichelostemma capitatum* were collected between Rosario and San Fernando but not seen south of that point. *Muilla serotina* was found near the mouth of San Antonio del Marr Canyon (Johnson's Ranch), and *Bloomeria crocea* on the Santa Maria Plains twenty miles or so south of San Quintin. *Quercus dumosa*, *Adenostoma fasciculatum*, *A. sparsifolium*, *Heteromeles arbutifolia*, *Arctostaphylos glauca*, *A. drupacea*, *Juniperus californica*, and *Pinus quadrifolia* reach their southern limits at approximately the same point near the southern tip of the Sierra San Pedro Martir. *Arctostaphylos bicolor* disappears from the foothills of the mainland but reappears on Cedros Island, while *Heteromeles arbutifolia* is again present in the mountains of the Cape Region.

In the higher mountains of the Sierra San Pedro Martir occur the southernmost known limits of *Pseudotsuga macrocarpa*, *Pinus lambertiana*, *P. jeffreyi*, *P. contorta murrayana*, *Libocedrus decurrens*, and *Quercus chrysolepis*. *Populus tremuloides* and *Abies concolor* reach the southernmost extension of their peninsular range here, but occur somewhat further south on the mainland of Mexico. *Rhus laurina* disappears near San Quintin, and *R. integrifolia* is plentiful to a point

about half way between Rosario and San Fernando. *R. laurina* reappears in the Sierra San Francisquito, near La Paz. *Fouquieria splendens* gives way to *F. peninsularis* in the vicinity of Punta Prieta, and a yucca without flowers or fruit which appeared to be *Y. mohavensis* was seen intermingled with *Y. valida* some miles to the north of this place.

For a distance of about thirty-five miles south of El Marmol Idria is the most conspicuous tree of the low hills. Growing among huge granitic boulders carved into fantastic shapes by the action of wind and changing temperatures, it gives the entire area a weird aspect suggestive of primitive forests tenanted by monstrous saurians. The smooth bark varies from a light yellowish green to nearly white and is nearly two inches thick. The woody skeleton of the plant is a dictyostele with the perforations arranged rather closely in indefinite spirals. The woody cylinder is only two or three inches thick and surrounds a pith that may be a foot in diameter at the base of the larger trees. The pith is quite juicy and has a sweet taste accompanied by a decided bitter tang that becomes stronger as the pulp is chewed. During years of light rainfall and short feed thousands of the "Cirio" trees, as the Mexicans call them, are cut down, split open with a few blows of an axe, and left for the cattle to dig out the pith which they eat greedily.

At Cataviñá, thirty miles south of El Marmol, are two canyons where two species of native palms occur. The tall, graceful stems of *Washingtonia filifera gracilis* and the shorter trunks of *Glaucothea armata* crowned with leaves a yard broad afford a pleasant change from the monotony of the Idria and *Pachycereus* forests of the neighboring hills. These palms also occur in a canyon some twelve miles south of Cataviñá. Travelers fill all available water containers at this canyon, for ordinarily there is no water between there and Punta Prieta, 85 miles south.

We filled our canteens and water-can, but there was plenty of water at Laguna Seca Chapala, which is usually a flat plain five miles across without a drop of water in sight. Ordinarily one drives straight across it as rapidly as the condition of the "road" permits, for the tires sink into the ash-like silt and send up clouds of choking dust. But in February a cloudburst had drenched the surrounding hills and turned the "dry" lake to a decidedly wet one several feet deep. We were forced to detour about five miles around the upper end of the lake over a jumble of jagged granite rocks varying in size from chunks as small as a man's head to some as large as a good sized wash tub. Nearly three hours were consumed in negotiating that detour, for in a number of places some of the worst rocks had to be rolled out of the way. On the nearby hills the commoner shrubs are *Covillea tridentata*, *Prosopis pubescens*, *Elaphrium microphyllum*, *Fouquieria splendens*, several species of *Lycium*, and the ever present *Pachycereus*, *Ferocactus*, and *Opuntia cholla*.

Splendid collecting was found on the desert hills and sand dunes about half way between Laguna Seca Chapala and Punta Prieta. Abro-

nias filled the air with fragrance and covered acres with masses of delicate tinted blossoms. *Yucca valida* was conspicuous. *Pachycereus* was plentiful. *Ephedra* was in full bloom. *Cenchrus palmeri* made kneeling extremely painful and was literally a thorn in the flesh far too often, for in the excitement of collecting some fine specimen not previously seen it was very easy to forget the thorns and drop on one knee or incautiously place eager fingers on the vicious burs. A large number of herbaceous annuals kept us occupied for several hours, despite the fact that we had been told by a cactus collector, Mr. Howard E. Gates, that collecting would be poor south of Cataviñá. About a mile north of Punta Prieta we found our finest specimen of *Pachycereus pringlei*, a monarch fifty-five feet tall. At about the same place we encountered *Fouquieria peninsularis*. It has a deeper red corolla than has *F. splendens*, but the flowers make a poorer display because the panicles are much smaller than those of the northern species.

Punta Prieta is an abandoned mining town and its population varies almost overnight from zero to fifteen or twenty people. Mexicans move into the deserted adobe houses where they stay while the men hunt antelope and deer in the neighboring Sierra de San Borjas, or prospect in that range and the Sierra Columbia toward the west. They seldom stay long for the water is so heavily impregnated with salt and alkali, to say nothing of other minerals, that we wouldn't use it in the radiator of the Ford!

There is little change in the flora from Punta Prieta southward almost to Calmallí. A few miles north of Calmallí the last struggling specimens of *Idria* reach their southern limit. *Viscainoa* is plentiful along some arroyos, and the "forest" of the desert plains is made up almost entirely of cactus. *Pachycereus*, *Lophocereus*, *Lemaireocereus*, *Opuntia*, *Echinocereus*, and *Ferocactus* compose a large part of the flora. *Elaphrium* grows among the cacti, and *Acacia*, *Pithecolobium*, and *Prosopis* line the arroyos.

Ten miles south of Calmallí we saw our first specimen of *Ibervillea sonorae*, a peculiar cucurbit with a huge subterranean stem. Another ten miles south we collected *Marsilea* in abundance within ten feet of the base of a healthy specimen of *Pachycereus pringlei*! The margin of the dried up rain-pool had extended some yards past the cactus but apparently its feet had been soaking for such a short period that no ill effects resulted. Vernal pools do not last long in this region of rapid evaporation.

At San Ignacio a small stream is fed by a fine spring a short distance up the canyon above the town. Dates, grapes, bananas, a little sugar cane, and a few oranges are grown in the narrow valley, and all of the ground for which water is available is cultivated. The valley is a picturesque spot, for it is the first oasis south of Rosario, 328 miles to the north. The hills on both sides of the valley are dry and barren, supporting scanty growths of scrubby "chollas," "cardons," "palo fiero," "mescal," and "torote." Two miles up the canyon the earth is as parched as the hills on either side of the valley, and a few miles down the canyon to the west the water again disappears leaving it a "dry and thirsty land."

The hills between San Ignacio and Santa Rosalia are of volcanic origin and the lava flows that coursed down the slopes of Las Tres Virgenes in 1784 are still hideously raw and rugged. A few torote trees (*Elaphrium*), two or three species of *Agave*, and a few spiny leguminous shrubs do a little toward softening the harshness of their profiles, but several centuries more must pass before these inhospitable rivers of rock take on the gray-green mantle of the adjacent land which escaped the recent devastating heat of the Three Virgins. It is a hot, monotonous, desolate region, and in the immediate vicinity of Santa Rosalia is made more desolate by the fumes from the copper smelters.

Forty-two miles south of Santa Rosalia, at Mulegé, *Rhizophora* mangle grows along the estero, sugar cane, corn and melons thrive in the rich valley soil, and date palms, banana trees, and coconut trees give the sleepy little town an exotic, tropical charm hardly equaled anywhere else on the peninsula. In September of this past summer extraordinary high tides coming at the same time that the water from a cloudburst in the mountains rushed down the narrow valley almost completely demolished over half of the village of Mulegé. The adobe buildings melted down almost as rapidly as wet sugar when half submerged by the high water. The mountains in this vicinity, though not high, are exceedingly rugged volcanic peaks and little is known of their flora. *Lysiloma candida* is a striking tree of the lower canyons, the smooth bark glistening as though white-washed, and many of the trees show the devastating effects of the tanbark harvesters who shipped hundreds of tons of the bark from Santa Rosalia a few years ago.

From Mulegé the road leads one southward past the beautiful waters of Bahia de la Concepcion, past Canipole where good water is obtainable, and over steep, rocky, narrow grades and across lava strewn plains to Comondu. A native fig, *Ficus palmeri*, is a conspicuous tree on the rocky walls of the narrow canyons, the flattened roots clinging to the naked rocks or dropping in stringy cascades thirty or forty feet over precipices in search of scanty moisture in tiny crevices below. The same crops, excepting the coconuts, are grown at Comondu as at Mulegé. The townsfolk were in the midst of manufacturing their annual supply of "panoche," the dark brown native sugar, at the time of our arrival. *Pithecolobium dulce* is grown for a shade tree and for the fruit, and *P. confine* is common along the arroyos. The seeds of the latter species are ground after roasting and used as an adulterant in coffee or to impart a peculiar flavor to chocolate. According to the natives, the young pods are used to make ink by soaking them in water for a few days. The resulting dirty brown fluid is hardly comparable to our inks. *P. confine* is one of the many shrubs called "palo fiero" in Baja California.

For the most part, the road from Comondu to La Paz skirts the monotonous Magdalena Plains, where the shrubs are mostly small, thorny, and scattered. *Euphorbia misera*, *Pedilanthus macrocarpus*, *Yucca valida*, *Pachycormus discolor*, *Fouquieria peninsularis*, several species of thorny leguminous shrubs and a number of cacti strike the

dominant note in the landscape. *Gossypium harknessii* occurs at a few points along the coast where arroyos carry water to the ocean during the rainy season. The creeping stems of the peculiar *Machaerocereus eruca*, or creeping evil cactus, cover extensive areas, and a few small composites add a touch of color to an otherwise drab expanse of dusty gray.

In the vicinity of La Paz, and from there south to the tip of the peninsula, the country gives evidence of a heavier rainfall. The vegetation is that of a tropical semi-desert area, and the vegetation is heavy only in the better watered valleys. From Ribera to San José del Cabo the summer rains bring up a thick growth in a surprisingly short time, according to the reports of others who have visited the area after the rains, but it was dry and rather uninteresting in May, the very end of the dry season. Throughout this region *Tecoma stans* is common along the washes and bears gorgeous masses of bright yellow flowers during April and May. *Lysiloma candida* is abundant, forming nearly pure stands in the mountain canyons. *Operculina aurea*, a yellow-flowered morning-glory, clambers over the shrubbery and vies with *Tecoma stans* in brightening the hillsides and arroyos. *Pachycereus pecten-aboriginum*, with its huge, burr-like fruits, is commoner than *P. pringlei*, and *Lemaireocereus thurberi* is common. *Pithecolobium dulce* and *Enterolobium cyclocarpus* are used as shade trees about the towns, and the trunks of the latter are used for making their dugout canoes.

Sugar cane, coconuts, dates, papayas, mangoes, melons, and bananas grow well. Frost is unknown in the lowlands and a variety of smaller crops are cultivated wherever water for irrigation is available. Several thousand acres in the vicinity of San José del Cabo, Ribera, and Eureka are planted to tomatoes annually and the crop shipped to the United States to supply the early market. In the Cape Region the climate is said to be delightful during all parts of the year except during the rainy season which extends from late June to the early part of September.

Excepting the Cape Region and the higher mountains of the northern part of the peninsula, Lower California is desert or semi-desert in character. Most of the shrubs are thorny, some have a very bitter taste or a disagreeable odor, and others combine two or more of these characters. Many of them, however, offset these objectionable features by the beauty or fragrance of their flowers, and some of them produce abundant food for man and beast. The peninsula boasts a considerable number of endemic genera and species, some of the former of which are *Pachycormus*, *Viscainoa*, *Machaerocerus*, *Xylomagra*, and *Clevelandia*. The number of endemic species is much greater.

Life zones from Arid Tropical to a scant representation of the Canadian Zone occur on the peninsula, consequently the flora is very diverse and presents numerous fascinating problems in geographical distribution, zonal range of critical species, and the probable centers of origin of the various elements making up the total flora. The vast expanse to be covered makes it difficult to obtain a comprehensive view

of the flora and the environmental factors operative in the area. The fluctuations in climatic conditions from one year to another add to the difficulty of securing complete collections within a reasonable period of time. But with all of the discouraging features connected with a careful survey of such a large area, Baja California, with its diverse, problematical flora, holds a strong attraction for the field botanist.

This trip, extending from April 2 to June 6, 1931, as well as three previous shorter trips into Lower California, was made possible by the interest and generosity of Mr. H. C. Dudley, of Duluth, Minnesota, and Mr. E. G. Dudley, of Exeter, California. Their aid is greatly appreciated and I wish to acknowledge my sincere thanks for their continued interest. Thanks are also due and gladly given to the Mexican Consul General at San Francisco, the Mexican Consul at San Diego, and numerous Customs Officers at various towns in Baja California, for the many courtesies extended us and for numerous aids in securing necessary permits. Señor Arturo Canseco, a prominent merchant in San Jose del Cabo, earned our lasting gratitude during the time we stopped there.

Dudley Herbarium, Stanford University.

RAINFALL PREDICTIONS FOR CALIFORNIA, SEASON OF 1931-1932

In October, 1931, an announcement was made by Dr. Geo. F. McEwen and Dr. A. F. Garton of the Scripps Institution of Oceanography that California would probably have a drier winter than normal this year. Their prediction was based on a study of records of Pacific Ocean temperatures which indicate that offshore water temperatures higher than average are followed by winters drier than average and conversely lower temperatures indicate wet winters. The offshore temperatures for 1931 have been markedly above average. This fact, in connection with the low point position of the 1931-32 season in the Bruckner precipitation cycle of 22 to 32 years, led to the belief that the season would be "dry."

Fortunately for California industrially and in other ways, precipitation records for the season on March 15, 1932, were above normal at all six stations south of San Francisco Bay whose records are commonly circulated by the United States Weather Bureau and much above the lows of recent years at the four stations in California north of San Francisco Bay as published daily in the press by the Weather Bureau.

On account of the great biological significance which attaches to precipitation records for California a study by H. B. Lynch, Consulting Engineer of the Metropolitan Water District, Los Angeles, published August, 1931, has interest for botanists. His paper, which is based on mission and other records as to weather, crops, droughts, floods, ice and snow, is entitled "Rainfall and stream run-off in Southern California since 1769". From the discussion in this paper one seems driven to the inference that we have not yet, at this time, reached the low point in our present series of drought years, which form only